Hadronic showers / missing energy in protoDUNE

Pawel Guzowski

MANCHESTER 1824
The University of Manchester

Outline

- Particle gun MC of pions and protons
- Studying the MC true energy deposited in protodune
- Quantifying energy associated to primary, and to neutral secondaries (photons, neutrons)

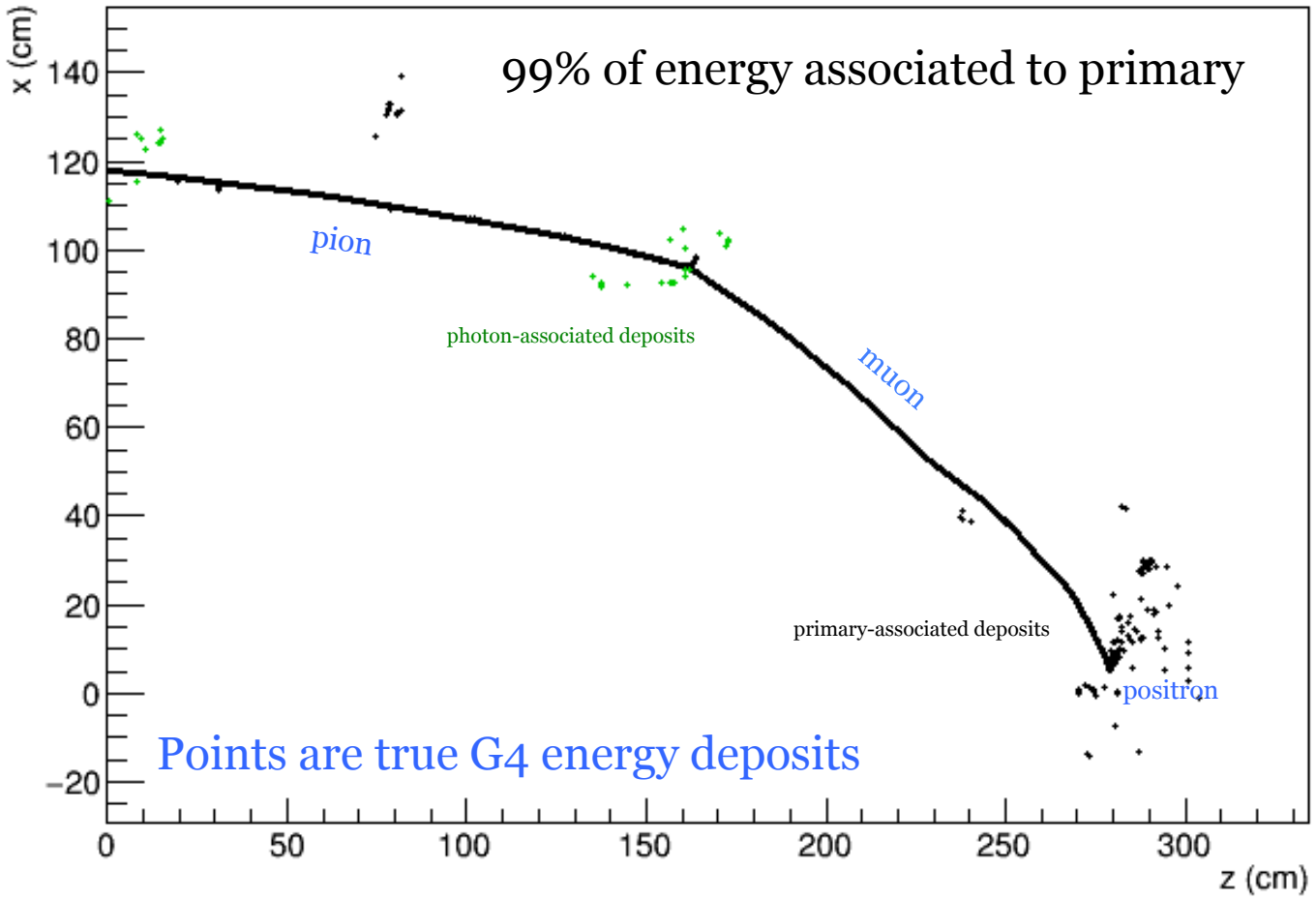
lar workflow

- Using dunetpc v05_13_00
  - protodune_v2 geometry
- protoDUNE_gensingle.fcl
  - Pion or proton, 0.1 – 3.0 GeV
  - x: 118.106 cm, y: 395.649 cm, z: 0 cm
- protoDUNE_g4single.fcl
- protoDUNE_detsim_single.fcl
  - Optical simulation is off, to save time
- protoDUNE_reco.fcl
- No noise / cosmics / multiparticle events

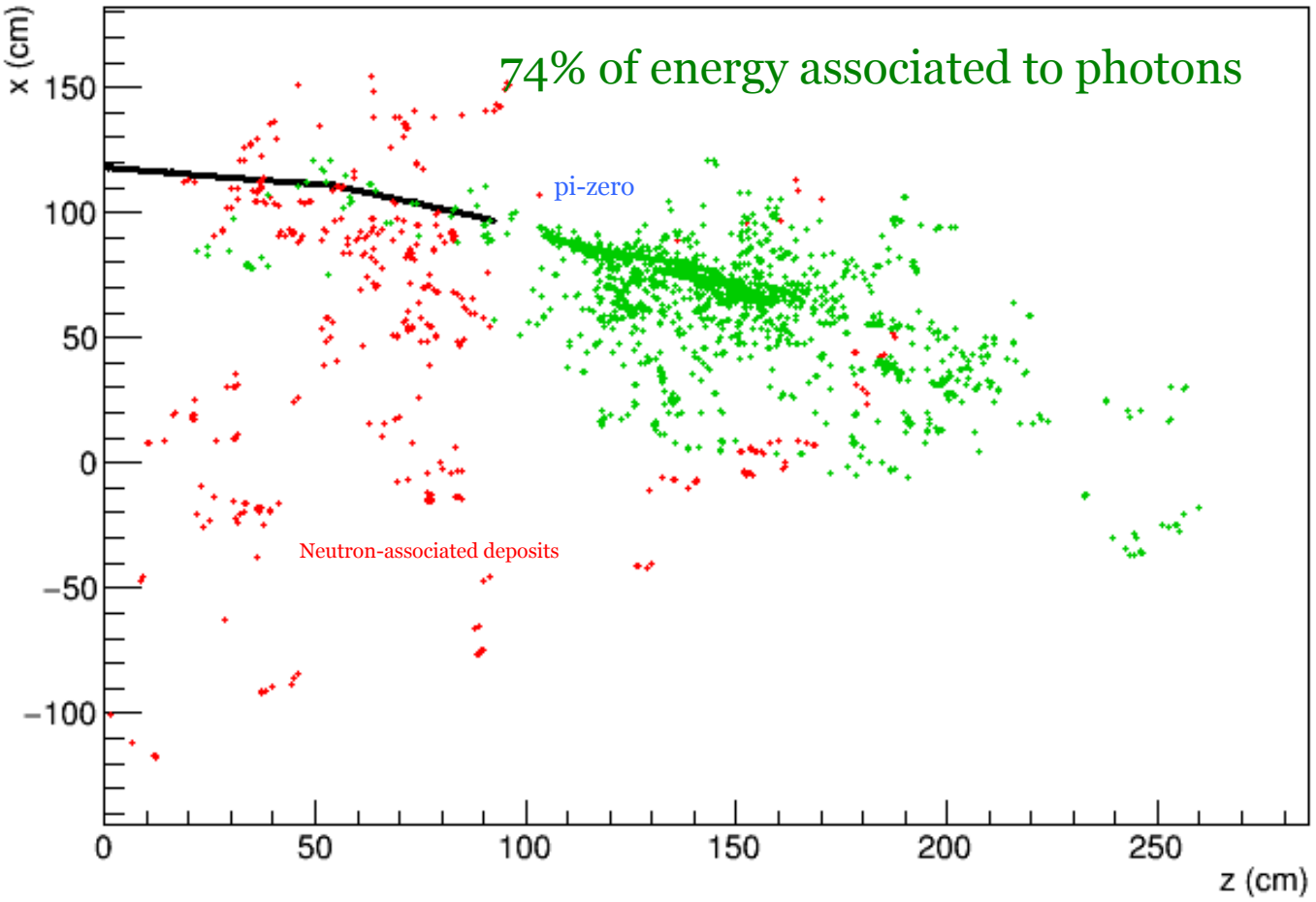
Analysis

- For now, only looking at the true energy deposits
- Associating each energy deposit to
  - Primary
  - Neutrons – in theory separated from primary
  - Photons – in theory separated from primary
- Calculating the fraction of energy deposited into those three categories

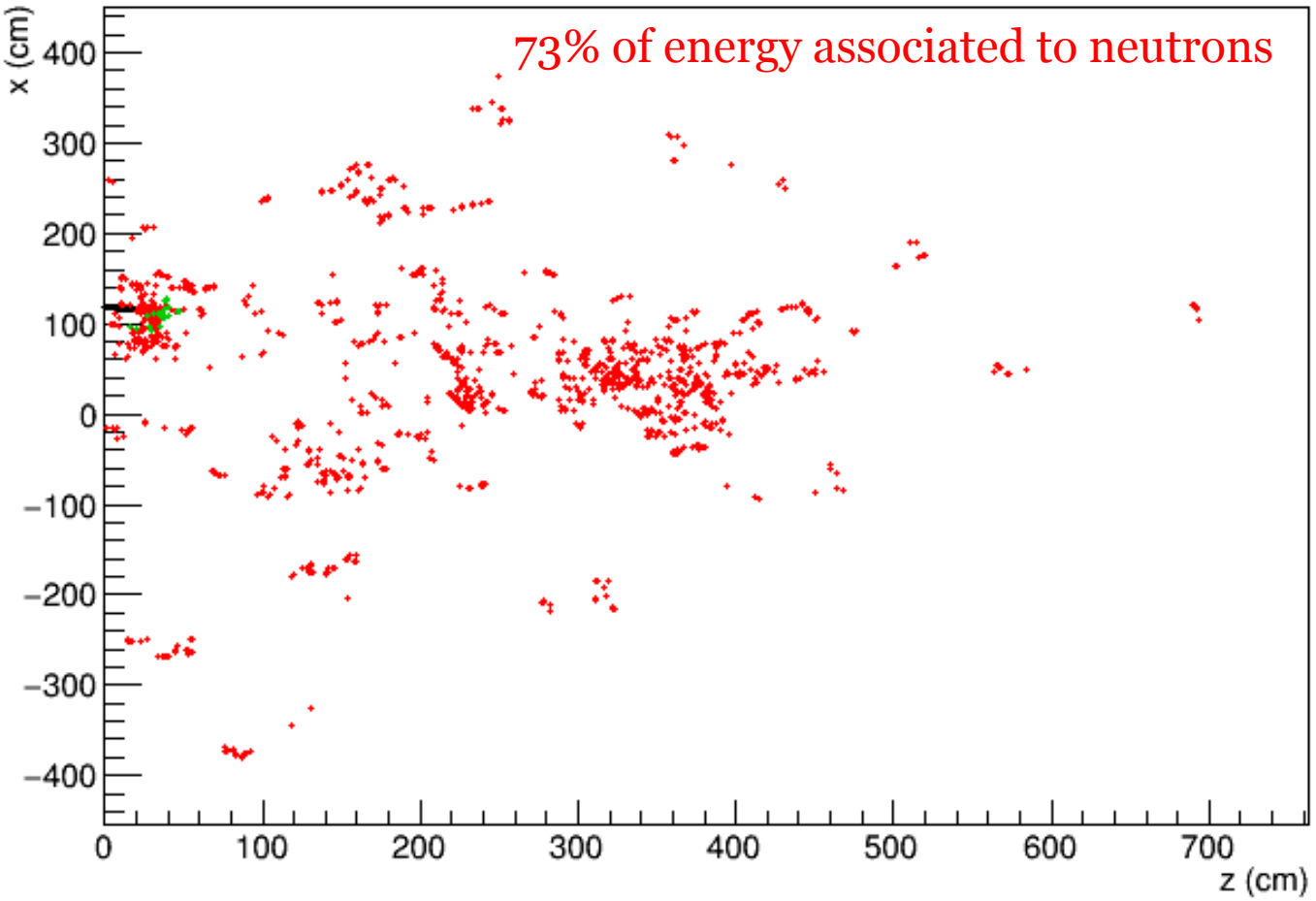
1.2 GeV pion


99% of energy associated to primary
pion
photon-associated deposits
muon
primary-associated deposits
positron
Points are true G4 energy deposits
x (cm)
z (cm)
140
120
100
80
60
40
20
0
−20
0
50
100
150
200
250
300

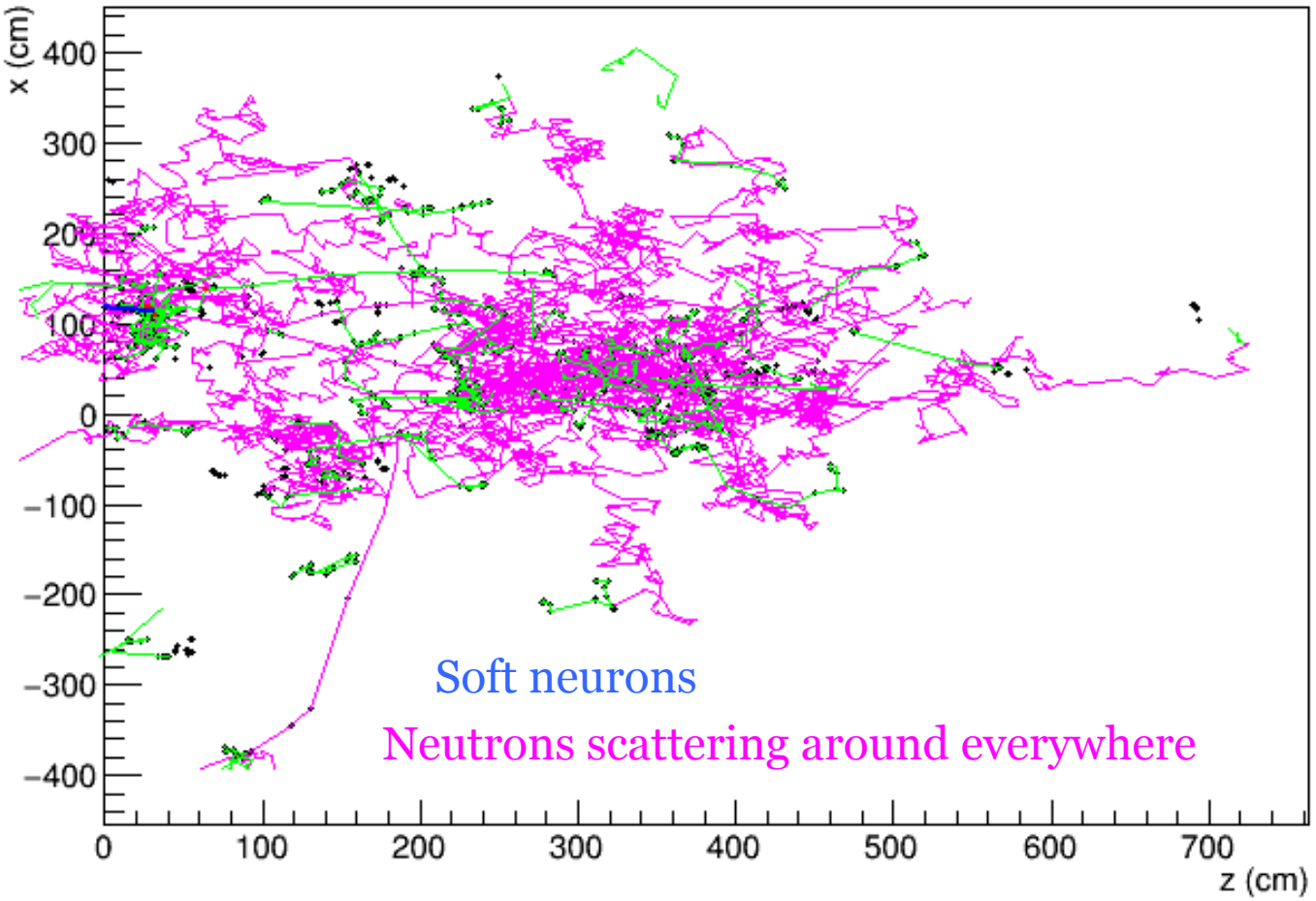
1.2 GeV pion


74% of energy associated to photons
pi-zero
Neutron-associated deposits
x (cm)
150
100
50
0
−50
−100
0
50
100
150
200
250
z (cm)

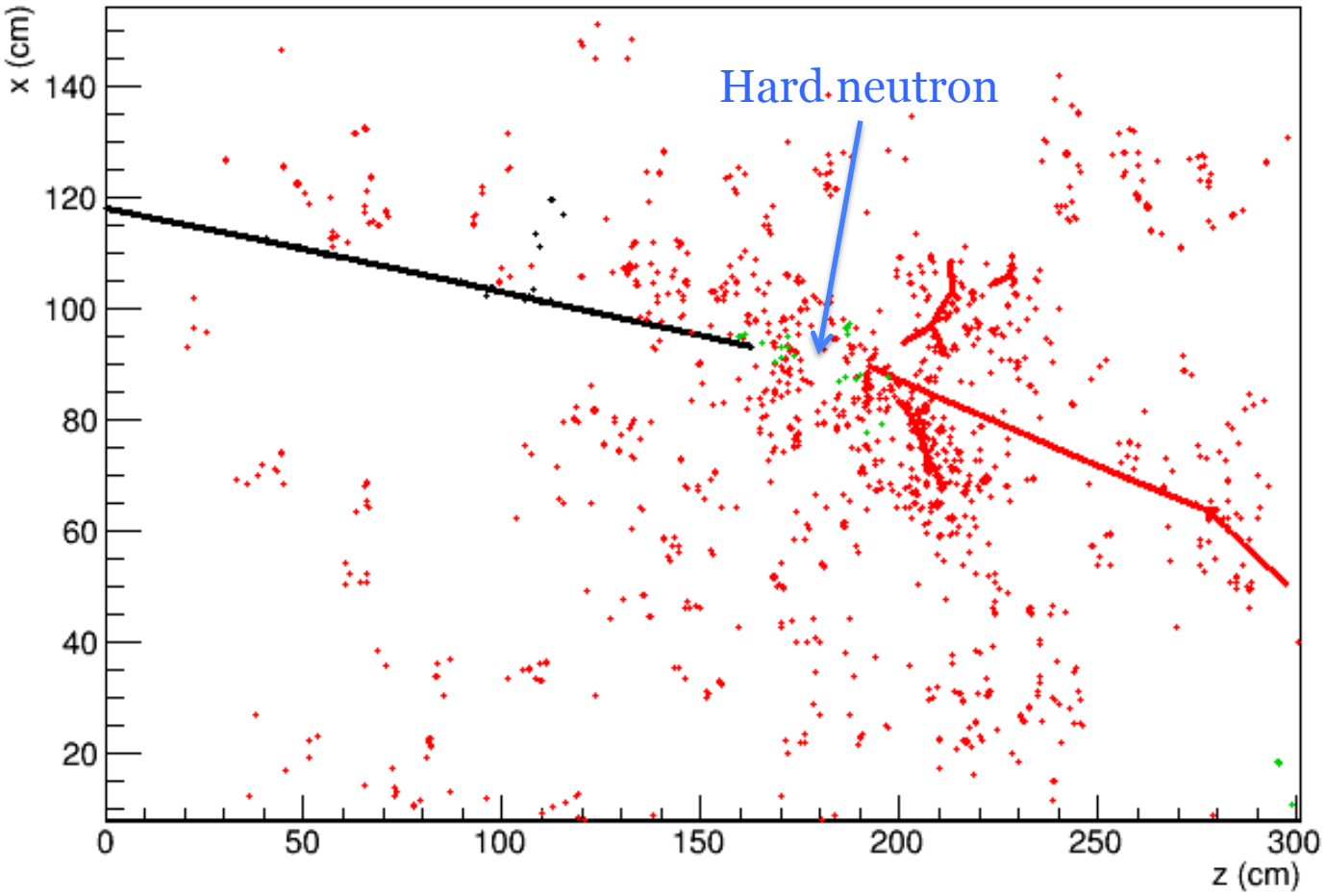
1.2 GeV pion


73% of energy associated to neutrons
x (cm)
400
300
200
100
0
−100
−200
−300
−400
0
100
200
300
400
500
600
700
z (cm)

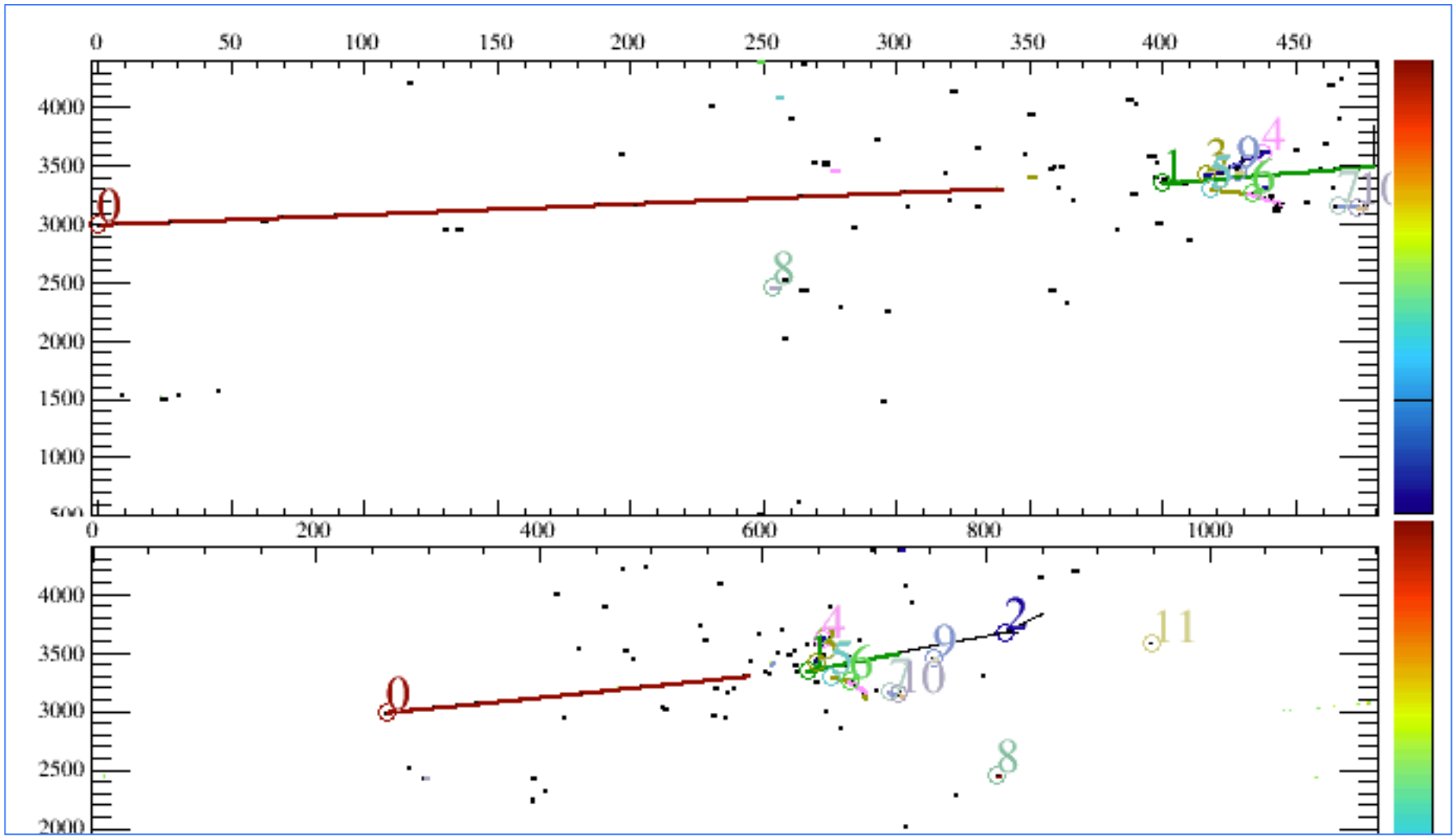
MC True particles



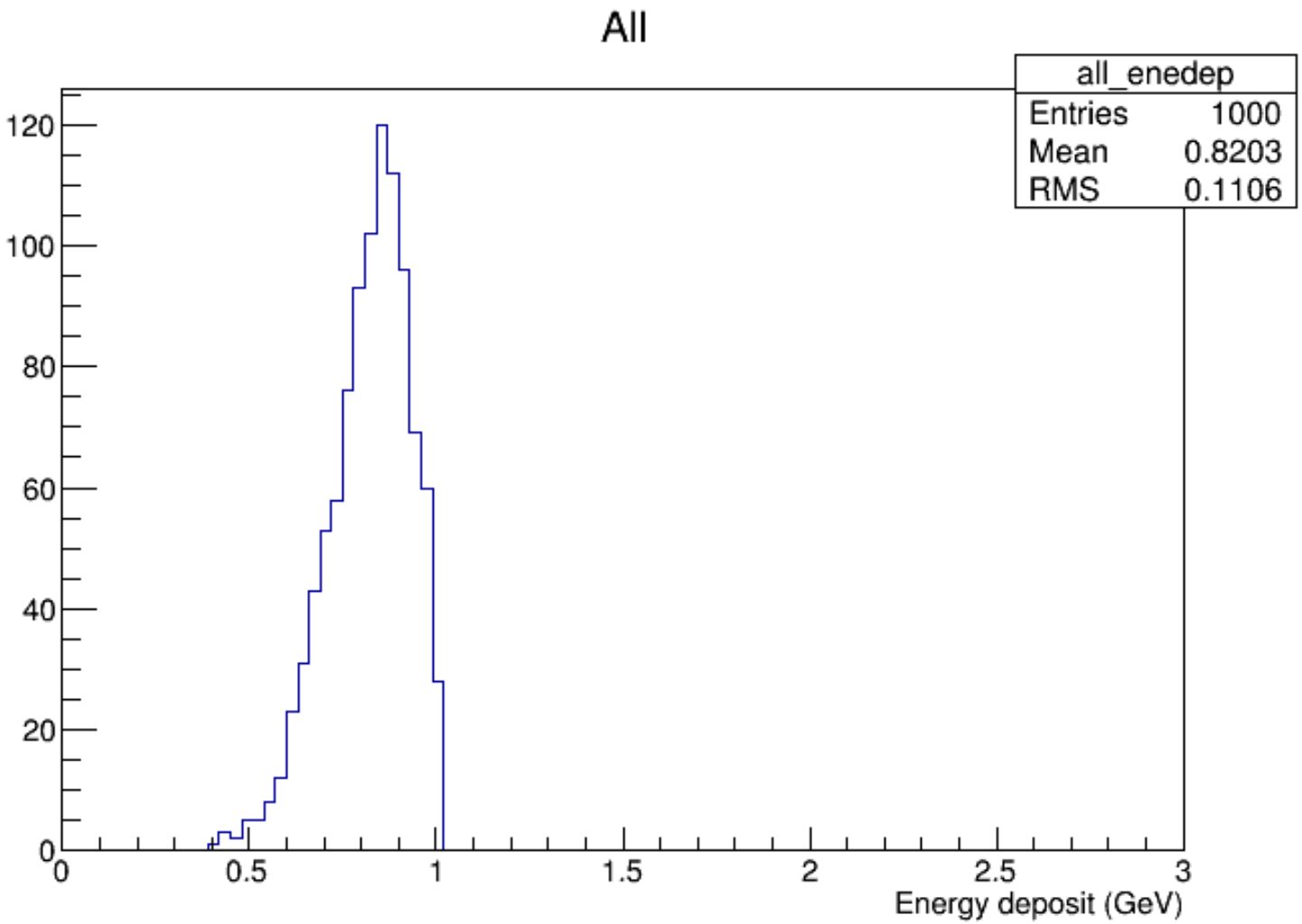
3.0 GeV proton



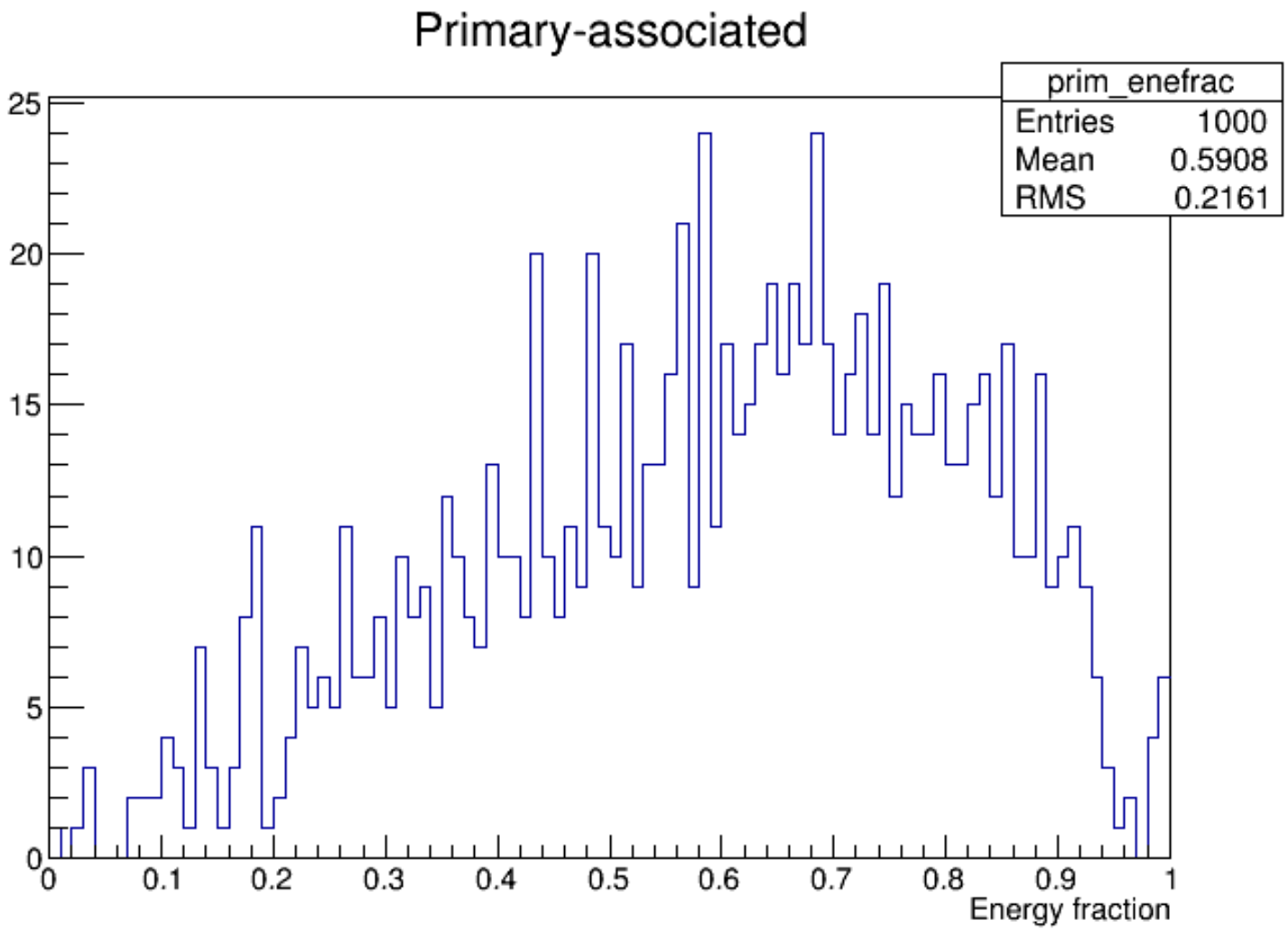
3.0 GeV proton – after reco



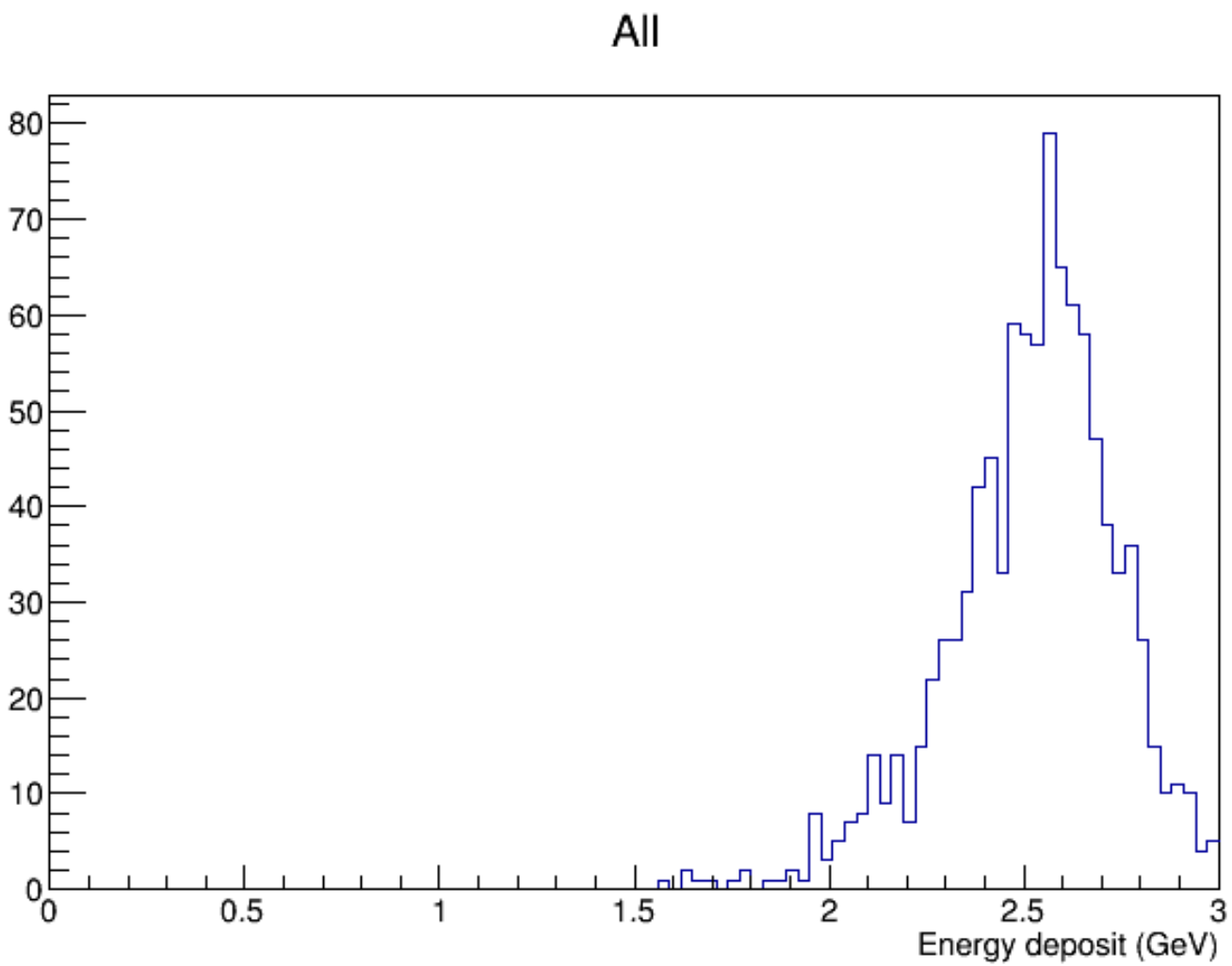
Total E deposit for 1.0 GeV pion



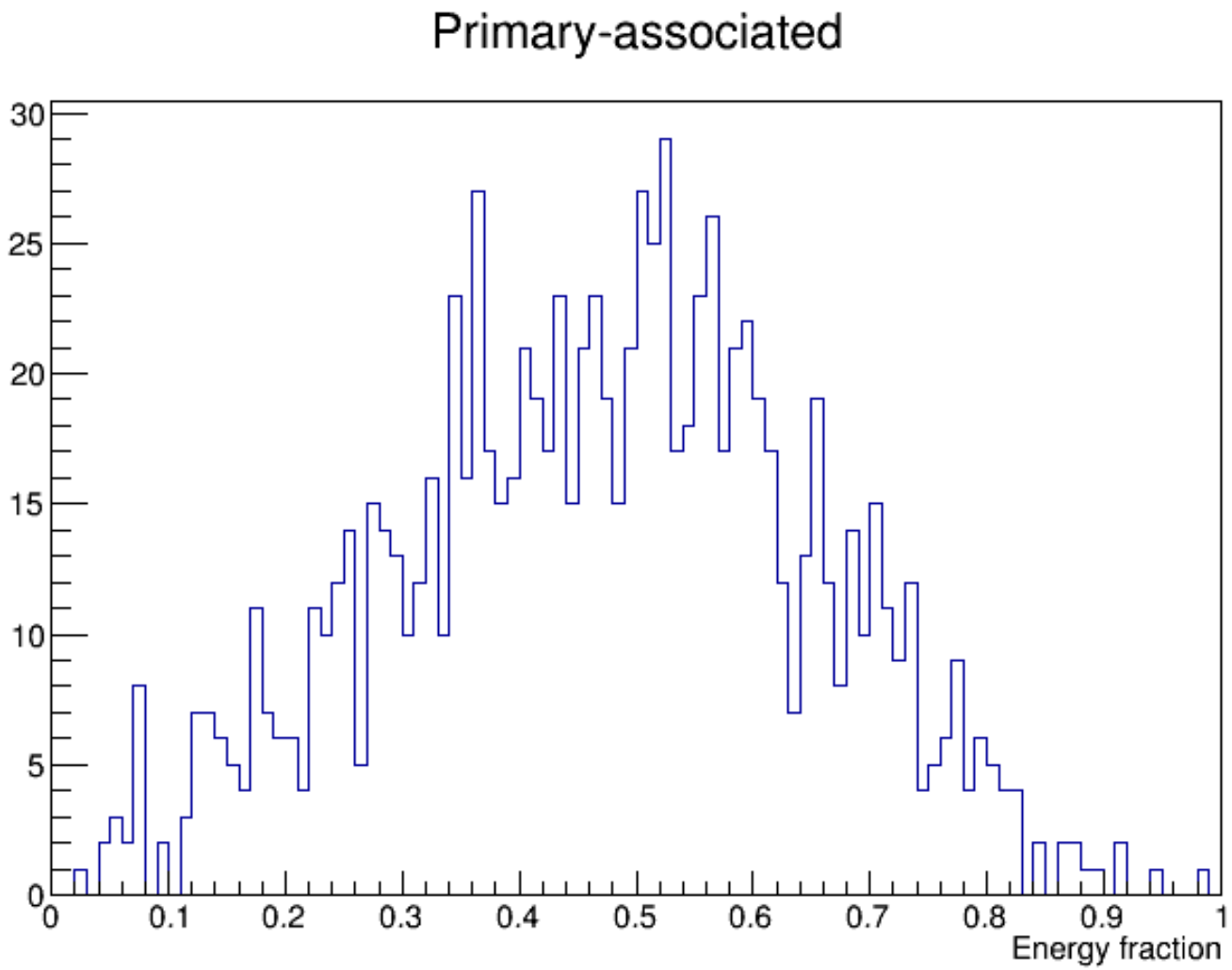
Energy fraction for 1.0 GeV pion



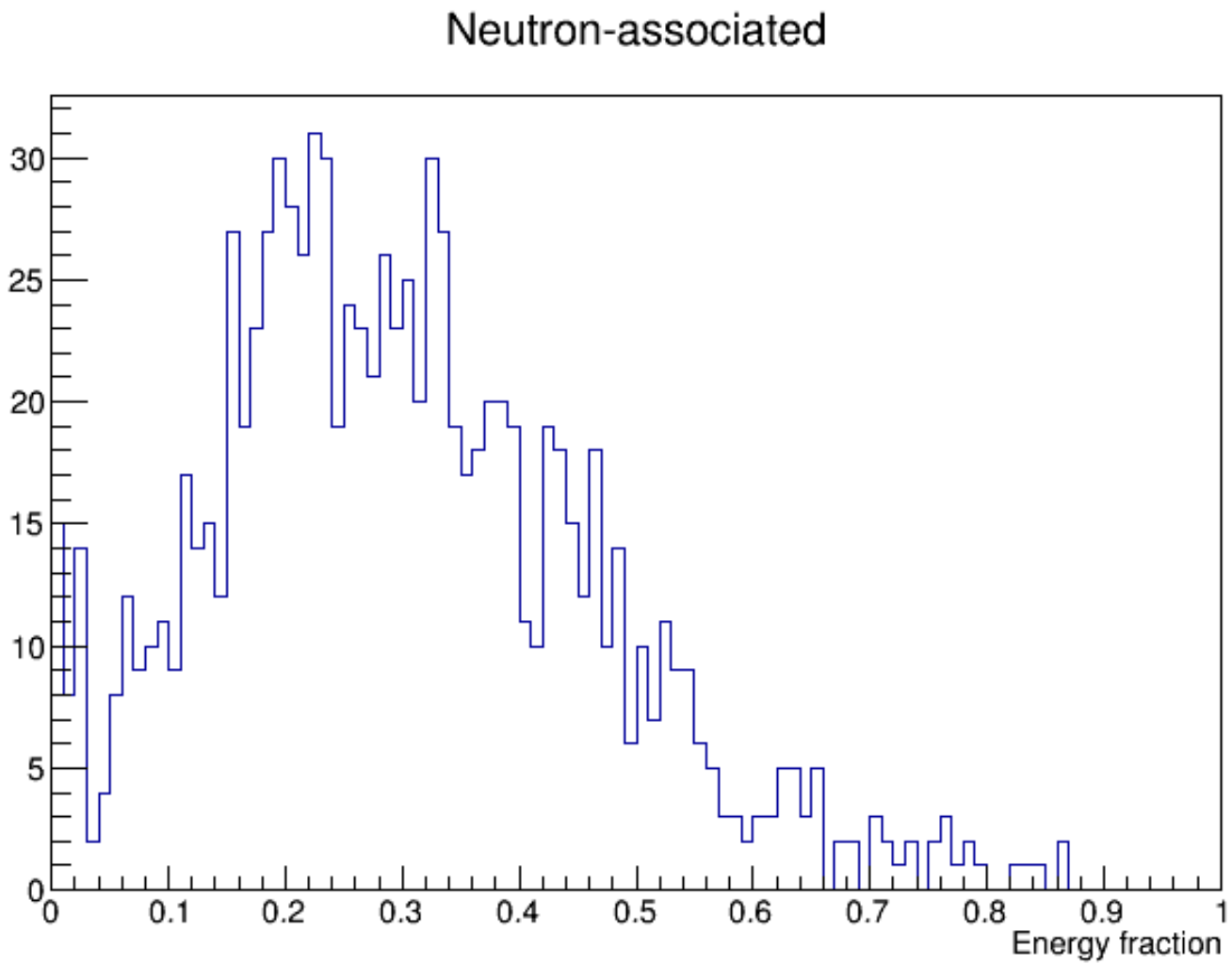
3.0 GeV pion – total E



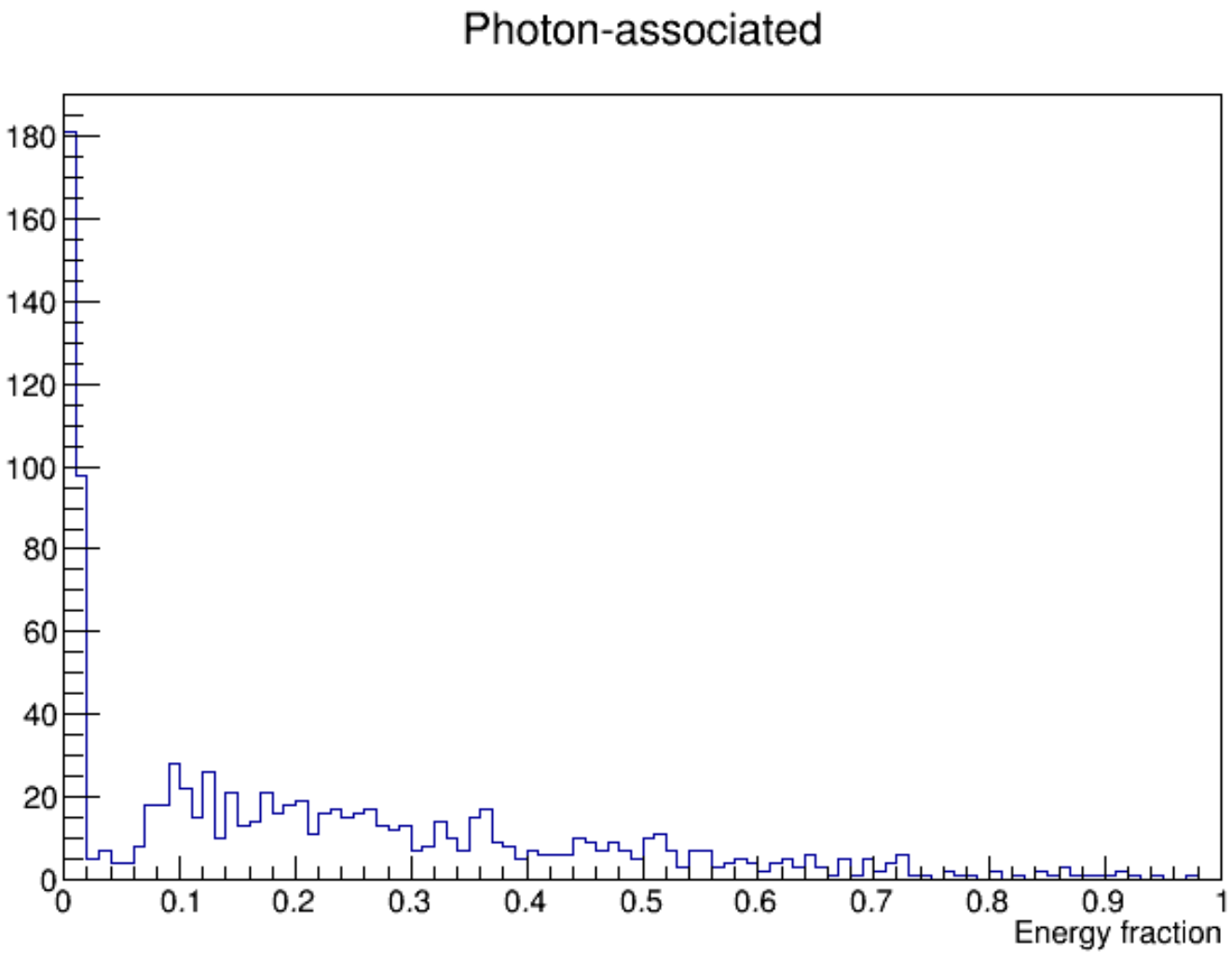
3.0 GeV pion – E fractions



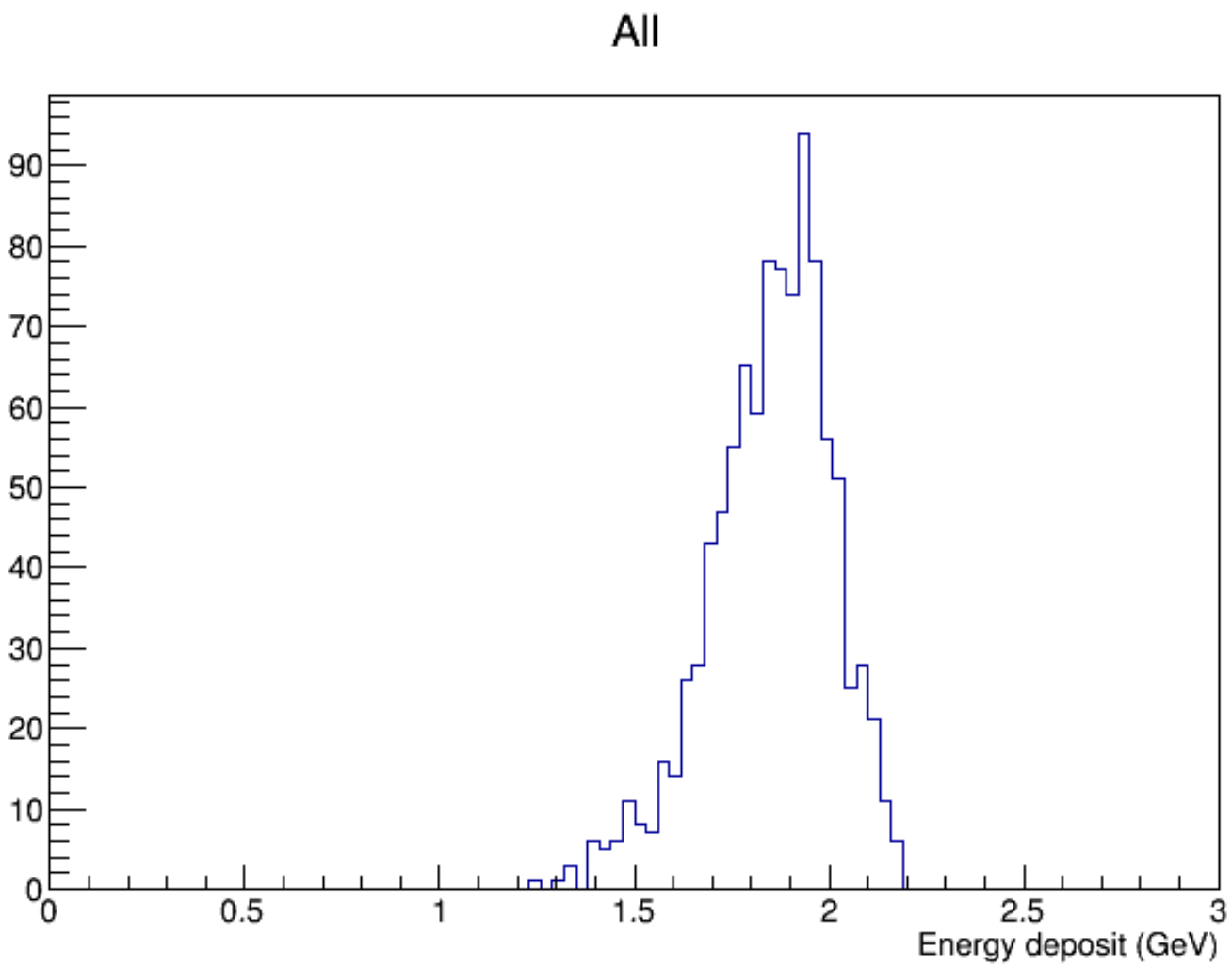
3.0 GeV pion – E fractions



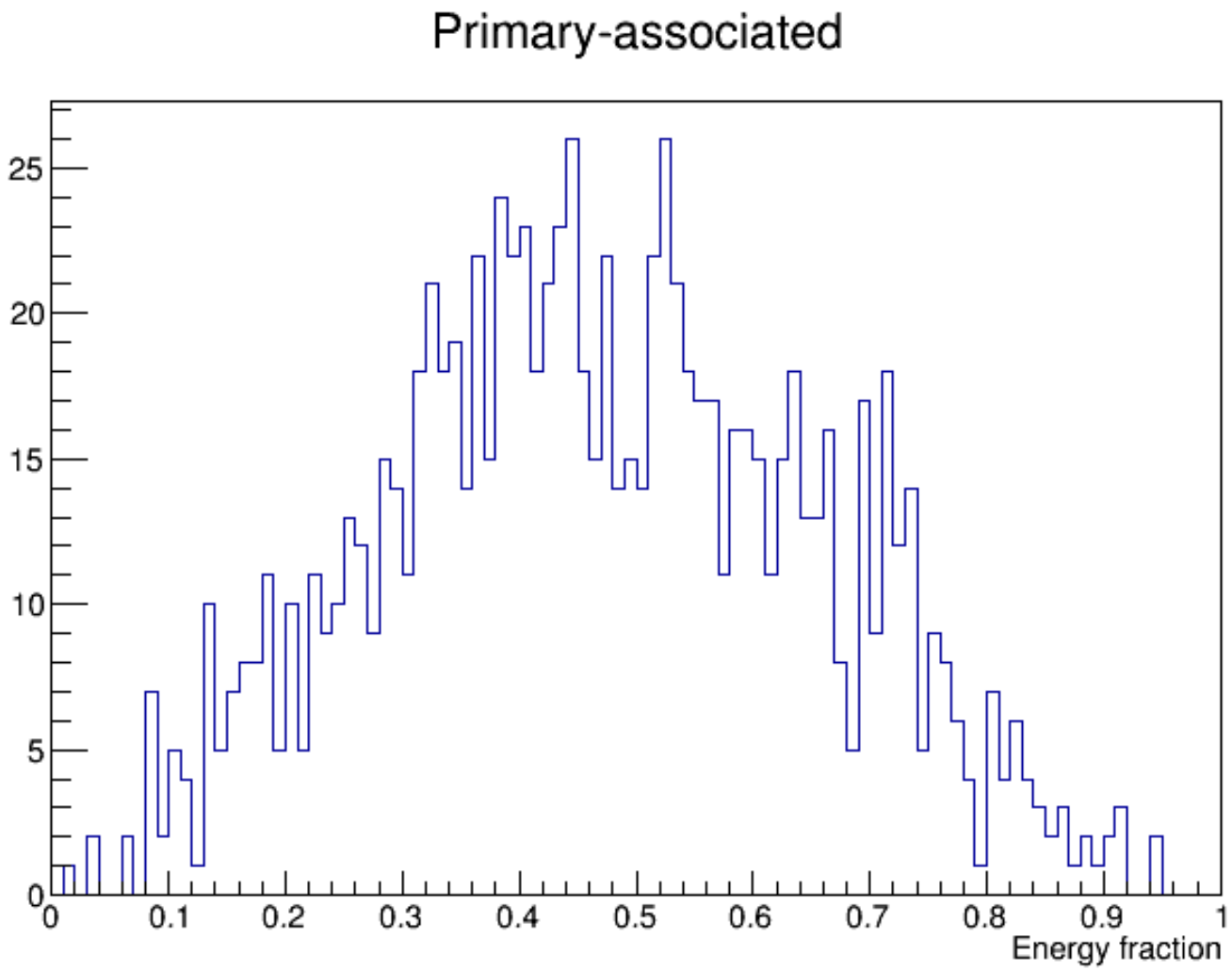
3.0 GeV pion – E fractions



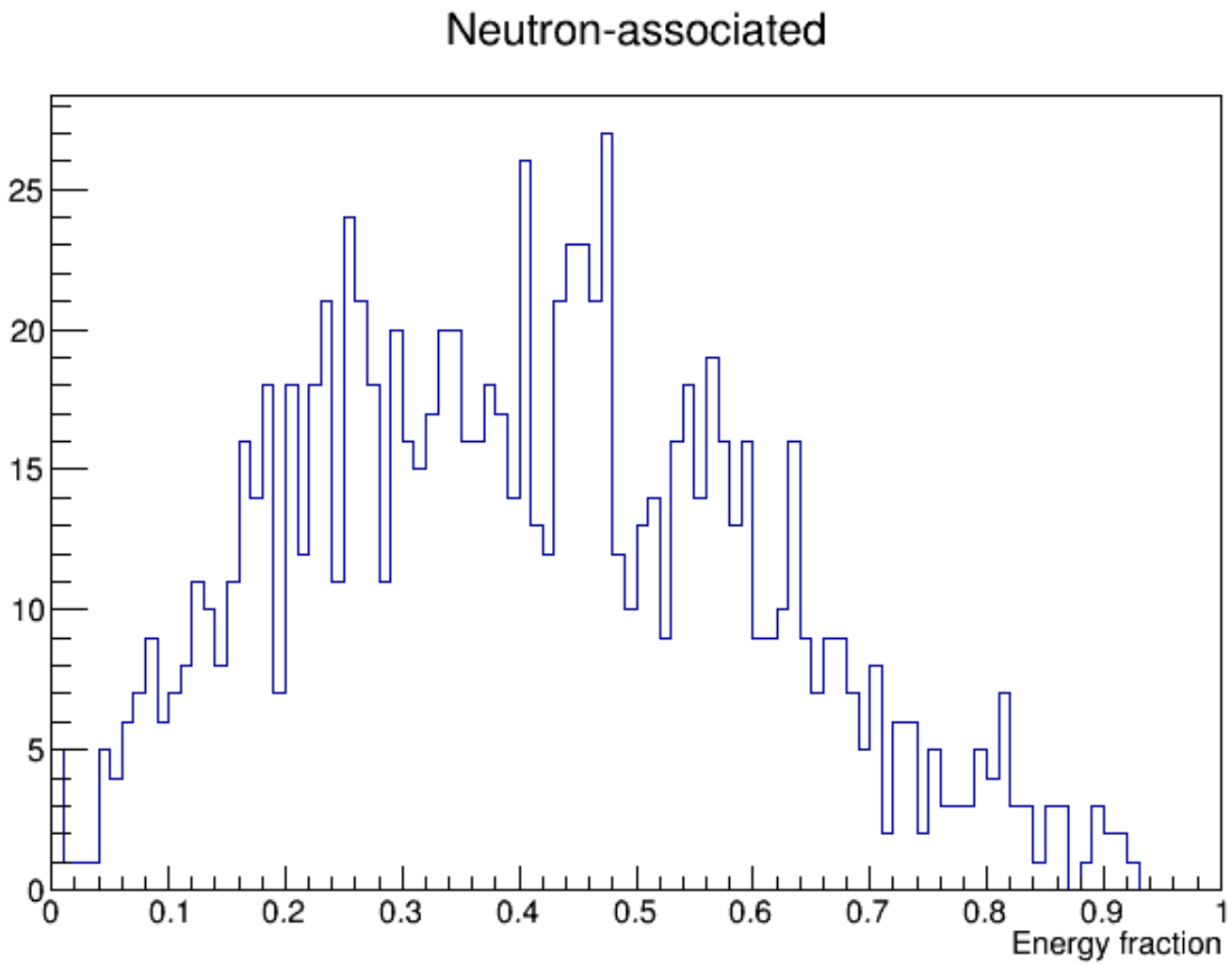
3.0 GeV proton – total E



3.0 GeV proton – E fraction



3.0 GeV proton – E fraction



Next steps

- What is reconstructable?
  - How much energy is lost due to low energy hits?
- Can optical information be used?
- Reconstruct the hard neutron interactions